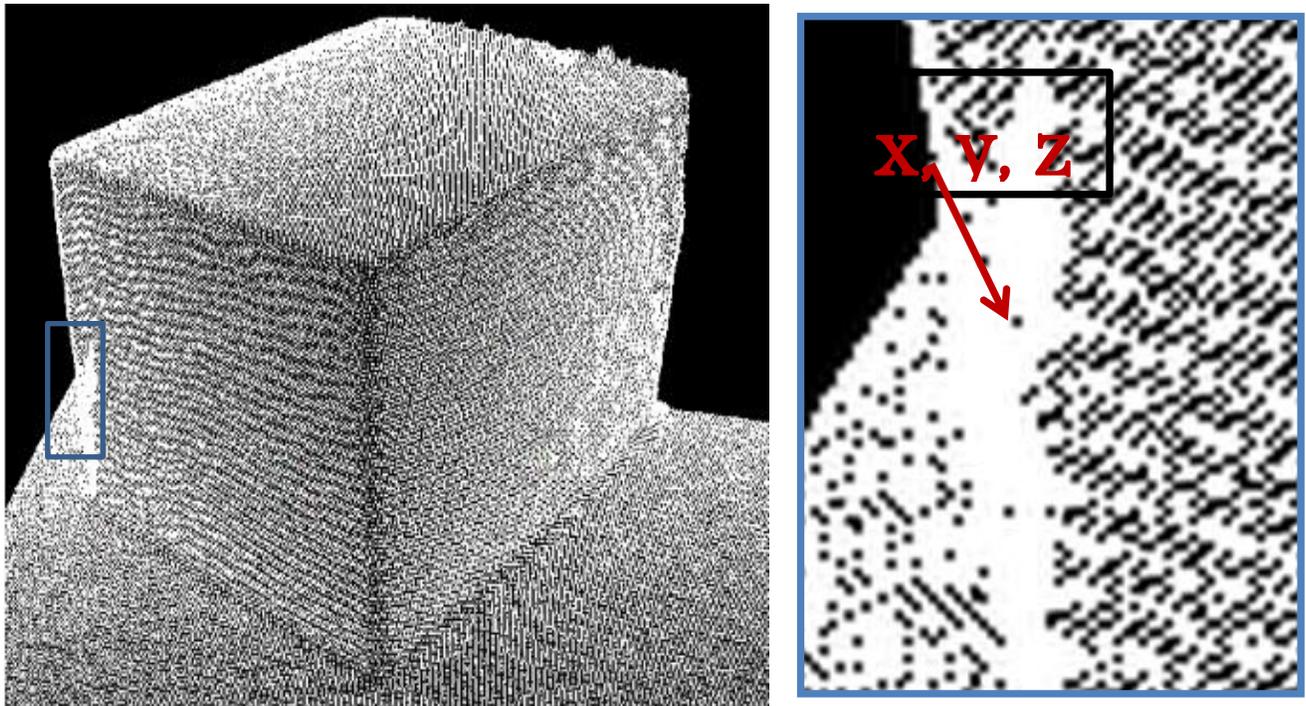# 3D Image Formats

2D image storage is pretty simple: rows and columns with an intensity value at each location. Adding a third dimension of information requires a different file structure. This paper will give a brief overview of some of the more commonly used 3D image formats.
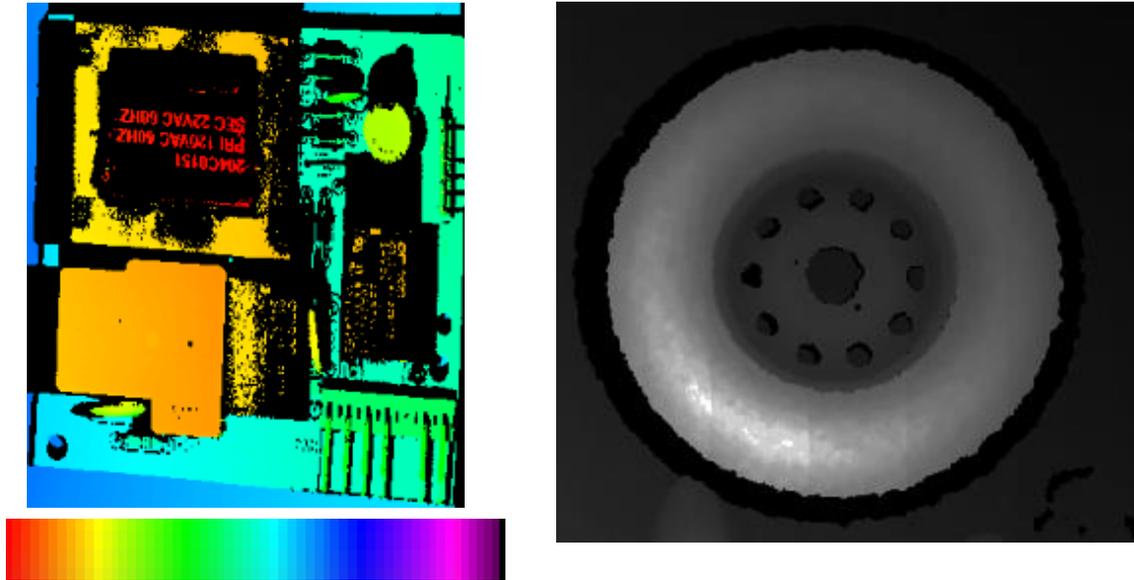
Image Formats: Point Cloud

"A **point cloud** is a collection of **multi-dimensional points** and is commonly used to represent three-dimensional data. In a 3D point cloud, the points usually represent the X, Y, and Z geometric coordinates of an underlying sampled surface." www.pointcloud.org

In the left image above, you can see the points throughout the image are defining a box sitting on top of a table. The right image is a zoomed-in view that shows individual points.

Image Formats: Depth Map

A depth map is similar to a 2D file format, where there are rows and columns with an intensity or color value, except the intensity value is the depth or distance from the camera sensor.

The example on the left uses color to represent depth using the color chart below it to represent close to far. The example on the right uses greyscale intensity to represent depth: white is close, black is farther away.

Image Formats: Polygon

- Designed to store three dimensional data from 3D scanners.
- Supports a simple description of a single object as a list of nominally flat polygons.
- Properties include: color and transparency, surface normals, texture coordinates and data confidence values.
- The format permits creating a **surface** out of points – it fills in surfaces between the points in a point cloud
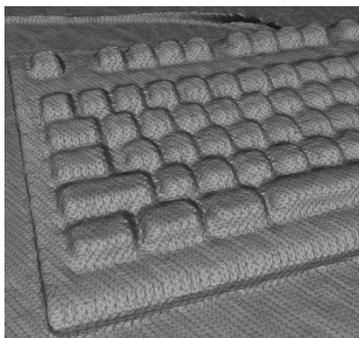
The example on the left is a polygon mesh of a keyboard. The zoomed-in view on the right shows how the surfaces are created with polygon shapes.
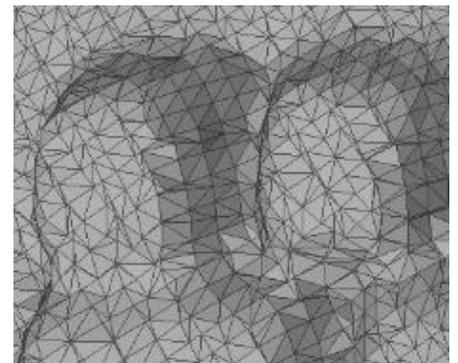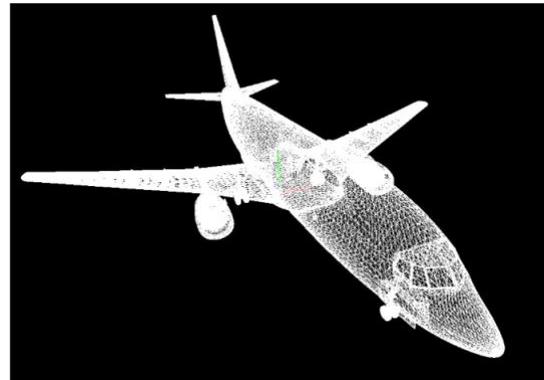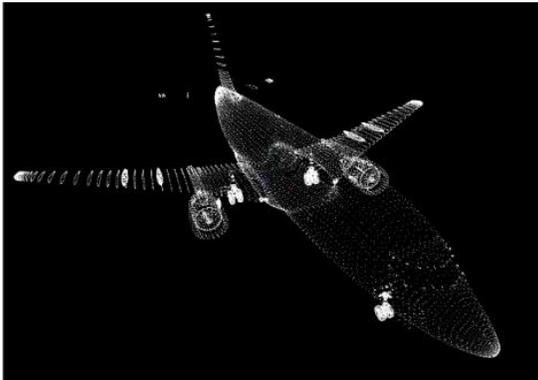
Image Formats: STL

- STL (StereoLithography) format is widely used across 3D printing, CAD software and modeling interfaces.
- STL format is ideal for comparing 3D scanned images and 3D CAD drawings.

Image Formats: Wireframe

The example above shows the same airplane information in a point cloud format on the left versus a wireframe format on the right.

Image Formats: Voxels
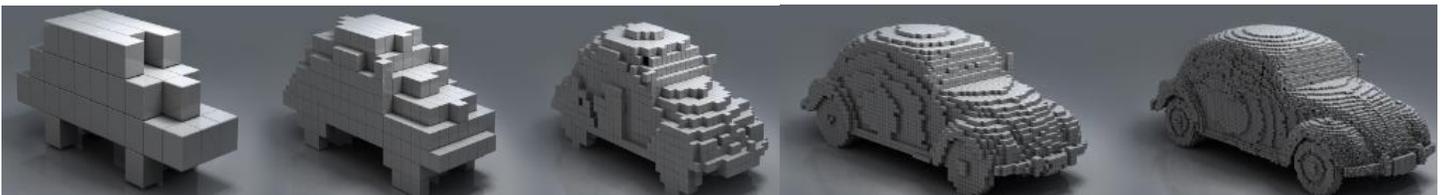
The Voxel format is a 3D rendering by using small boxes or voxels. The level of detail and complexity improves with smaller voxel size as shown above.